

Solid-Solid Vacuum Regolith Heat-Exchanger for Oxygen Production, Phase I

Completed Technology Project (2009 - 2009)



Project Introduction

This SBIR Phase-1 project will demonstrate the feasibility of using a novel coaxial counterflow solid-solid heat exchanger to recover heat energy from spent regolith at 1050

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C to pre-heat inlet regolith to 750

o

C, either continuously, or in 20kg batches. In granular solids the area of contacts between 'touching' grains is quite small. Thus, solid-solid conduction often plays only a minor role in heat transfer through granular solids (i.e., 'effective' conduction), and when an interstitial gas is present, heat transfer occurs primarily via conduction through the gas. If the granular solid is also flowing, then solids convection becomes a significant factor in overall heat transfer and effective 'conduction'. Under vacuum conditions, and at temperatures above 700

o

C, radiation will dominate most heat transfer processes; however, solids convection can also play a very significant secondary role. Utilizing judicious placement of radiation baffles, and a novel counterflow configuration, the approach proposed in this SBIR can accomplish the desired heat transfer between spent and fresh regolith with only one moving mechanical part, by making effective use of both radiative heat transfer and solids convection. Discrete-element simulations of regolith flow will be utilized to refine the concept. Utilization of an existing ~1.4 cubic meter partial-vacuum facility at the University of Florida will facilitate construction of feasibility demonstration prototypes during Phase-1 and/or Phase-2. The Phase-1 project will demonstrate the effectiveness of combining solids convection with radiative heat transfer to rapidly transfer heat from 1050C spent material to heat fresh regolith to 750C under vacuum conditions.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

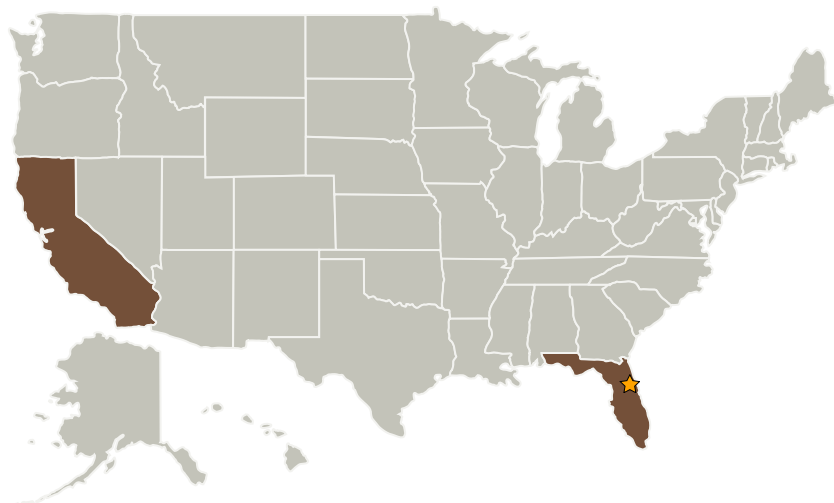
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Grainflow Dynamics, Inc.	Supporting Organization	Industry	Livermore, California

Primary U.S. Work Locations

California	Florida
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.2 Thermal Control Components and Systems
 - └ TX14.2.3 Heat Rejection and Storage